

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0763 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 07/27/00

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: ISOLATOR, PNEU CTRL PNL, TANK AEROFLEX	MC196-0009-3001 82378-0412
LRU	: ISOLATOR, PNEU CTRL PNL, TANK AEROFLEX	MC196-0009-3002 82378-0413
LRU	: ISOLATOR, PNEU CTRL PNL, TANK AEROFLEX	MC196-0009-3003 82378-0414

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

ISOLATOR, PNEUMATIC SYSTEM CONTROL PANELS AND TANKS.

REFERENCE DESIGNATORS:**QUANTITY OF LIKE ITEMS:** 62

18 OF -3001

23 OF -3002

21 OF -3003

FUNCTION:

DYNAMIC ISOLATION OF PANELS AND TANKS PREVENTING STRUCTURAL DAMAGE OF PNEUMATIC COMPONENTS AND TANKS FROM HIGH ENERGY VIBRATION GENERATED BY STRUCTURE.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0763-01

REVISION#: 1 07/27/00

SUBSYSTEM NAME: MAIN PROPULSION

LRU: ISOLATOR, PNEU CTRL PNL, TANK

ITEM NAME: PNEUMATIC SYSTEM ISOLATOR CTRL PNL/TNKS

CRITICALITY OF THIS

FAILURE MODE: 1/1

FAILURE MODE:

FAILURE TO DAMPEN STRUCTURAL VIBRATION

MISSION PHASE:

PL PRE-LAUNCH
LO LIFT-OFF
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

PIECE PART STRUCTURAL FAILURE

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

FAILURE CAUSES RUPTURE/LEAKAGE OF HIGH/LOW PRESSURE HELIUM LINE(S).

DURING ASCENT, THE PNEUMATIC/ENGINE HELIUM SUPPLY WILL BE LOST. ESCAPING HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0763-01**

DURING ASCENT, HELIUM SUPPLY TO ONE ENGINE WILL BE LOST. POSSIBLE UNCONTAINED ENGINE SHUTDOWN IF REDUNDANT LEG CANNOT PROVIDE ENGINE HELIUM REQUIREMENTS. EXCESSIVE HELIUM TANK PRESSURE DECAY (SM ALERT: 20 PSI/3 SECONDS; CAUTION AND WARNING: 1150 PSIA LOWER LIMIT) AND/OR REGULATOR PRESSURE OUT OF LIMITS WILL BE INDICATED BY SM ALERT (BOTH LEGS: 679 LOWER AND 806 UPPER) OR CAUTION AND WARNING (LEG A ONLY: 680 LOWER LIMIT AND 810 UPPER LIMIT).

PURGE OF AFT COMPARTMENT AND LH2/LO2 SYSTEMS WOULD DEPEND SOLELY ON THE LEFT ENGINE HELIUM SYSTEM RESIDUALS, RESULTING IN INADEQUATE ABORT PURGE, INCOMPLETE PROPELLANT DUMP, AND INGESTION OF CONTAMINATION.

LOSS OF PNEUMATIC LOW PRESSURE HELIUM MAY PREVENT THE APPLICATION OF CLOSING PRESSURE TO THE LO2 PREVALVE ACTUATORS AT ENGINE SHUTDOWN RESULTING IN PUMP OVERSPEED AND CAVITATION. MAY RESULT IN THE INABILITY TO MAINTAIN ENGINE HELIUM REQUIREMENTS. POSSIBLE UNCONTAINED ENGINE SHUTDOWN. POSSIBLE FIRE/EXPLOSION HAZARD.

STORED HELIUM PRESSURE IN THE ACCUMULATOR LEG AND SUPPLEMENTAL HELIUM FROM LV10 SHOULD BE ADEQUATE TO OPERATE THE LO2 PREVALVES AT MECO. LOSS OF HELIUM MAY PREVENT OPERATION OF VALVES FOR MPS DUMP.

HELIUM WILL NOT BE AVAILABLE FOR AFT COMPARTMENT PURGE.

AT MM303, ALL 6 ENGINE AND THE PNEUMATIC REGULATORS ARE ACTIVATED. BFS CAUTION & WARNING IS ACTIVATED FOR EACH REGULATOR. HARDWARE CAUTION & WARNING (A LEGS ONLY) IS ENABLED DURING DEORBIT PREPS. IN THE EVENT OF THE LOSS OF BFS MONITORING, THE B LEG REGULATORS ARE CLOSED.

PRIOR TO T-9 MINUTES, EXCESSIVE HELIUM LEAKAGE WILL BE DETECTABLE USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

(B) INTERFACING SUBSYSTEM(S):

SAME AS A.

(C) MISSION:

POSSIBLE LOSS OF CREW/VEHICLE.

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS C.

(E) FUNCTIONAL CRITICALITY EFFECTS:

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0763-01**

-DISPOSITION RATIONALE-

(A) DESIGN:

THE ISOLATOR CONSISTS OF A COILED, BRAIDED ROPE (MILW83420 TYPE I CRES) CONNECTED ON EACH SIDE BY METAL BARS. THE BARS CONSIST OF TWO MEMBERS ON EACH SIDE WHICH SUPPORT EACH RING AT ITS MIDPOINT TO MAINTAIN SPACING. THE METAL BARS HAVE MOUNTING HOLES ON EACH SIDE WHICH ALLOW STRUCTURAL ATTACHMENT.

THE -3001 CONFIGURATION CONSISTS OF 6 LOOPS OF 0.19 INCH DIAMETER WIRE ROPE HELD ON EACH SIDE BY 2024 T6 ALUMINUM BARS. THE BARS ARE HELD TOGETHER BY 20 SCREWS.

THE -3002 CONFIGURATION CONSISTS OF 10 LOOPS OF 0.09 INCH DIAMETER WIRE ROPE HELD ON EACH SIDE BY 304 CRES BARS. THE BARS ARE HELD TOGETHER WITH 13 WIRE CLAMPS (CRES).

THE -3003 CONFIGURATION CONSISTS OF 4 LOOPS OF 0.19 INCH DIAMETER WIRE ROPE HELD ON EACH SIDE BY 2024 T6 ALUMINUM BARS. THE BARS ARE HELD TOGETHER BY 20 SCREWS.

FAILURE TO DAMPEN STRUCTURAL VIBRATION COULD BE CAUSED BY THE STRUCTURAL SEPARATION OF THE TWO BARS AND FATIGUE FAILURE OF THE WIRE ROPE. FAILURE OF ANY MEMBER COULD ALTER THE DAMPENING CAPABILITIES OF THE ISOLATOR. STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF OPERATIONS.

(B) TEST:

ATP

EXAMINATION OF PRODUCT

STATIC LOAD TEST (2 UNITS)

MAXIMUM LOADS APPLIED IN TENSION, COMPRESSION, ROLL, AND SHEAR AXES

DYNAMIC LOAD TEST

1 MINUTE OF SINUSOIDAL VIBRATION APPLIED IN EACH OF THREE AXES

CERTIFICATION

SALT FOG

SHOCK

BENCH HANDLING

RANDOM VIBRATION

60 MINUTES IN EACH OF THREE AXES
SIMULATING FLIGHT G-LOADS

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0763-01**

STRUCTURAL LOAD TEST

NEUTRAL TO MAXIMUM DISPLACEMENT WITH LOADS APPLIED IS SHEAR, COMPRESSION, AND ROLL AXES OF MOUNT.

THE ISOLATOR WAS CERTIFIED WITH THE MAIN PROPULSION TEST ARTICLE (MPTA) WHICH INCORPORATES ALL CONFIGURATIONS UTILIZED IN THE MPS SYSTEM. MPTA EXPERIENCED NUMEROUS FULL DURATION STATIC FIRINGS OF THE MAIN ENGINE AT DIFFERENT PERFORMANCE LEVELS. THESE STATIC FIRINGS IMPARTED WORST CASE ENVIRONMENTS AT MAXIMUM OPERATING TEMPERATURES AND PRESSURES.

IN ADDITION THE -3001 CONFIGURATION WAS SUBJECTED TO 13.3 HOURS IN EACH OF 3 ORTHOGONAL AXES DURING VIBRATION TESTING OF THE MC284-0403-0003 2 WAY SOLENOID VALVE (VEHICLE SIMULATED MOUNTING).

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL

GENERAL CLEANING IS VERIFIED.

ASSEMBLY/INSTALLATION

MARKING ON PARTS BY BLACK EPOXY PAINT IS VERIFIED. INSPECTION VERIFIES DEGREASING ISOLATOR MOUNT BY VAPOR AFTER ASSEMBLY.

CRITICAL PROCESSES

HEAT TREATMENT OF MATERIAL IS VERIFIED BY INSPECTION PER REQUIREMENT. EXTERNAL SURFACE FINISH ANODIZED IS CHECKED AND VERIFIED. PART PASSIVATION OF RETAINER CLIPS IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

N/A

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING FOR SHIPMENT IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0763-01**

(E) OPERATIONAL USE:

ENGINE HELIUM TANK AND/OR REGULATOR PRESSURE ANOMALIES ARE INDICATED BY SM ALERT OR CAUTION AND WARNING. THE CREW ACTION IS TO FOLLOW THE NORMAL LEAK ISOLATION PROCEDURE.

PNEUMATIC ACTUATION HELIUM BOTTLE PRESSURE IS ON A DISPLAY IN COCKPIT. CREW ACTION IS TO FOLLOW NORMAL LEAK ISOLATION PROCEDURE. PRIOR TO MECO, ISOLATION VALVES (LV7, LV8) WILL BE REOPENED AND THE LEFT ENGINE HELIUM CROSSOVER VALVE (LV10) WILL BE OPENED.

PNEUMATIC TANK, REGULATOR, AND ACCUMULATOR PRESSURE ARE ON S/M ALERT FDA SYSTEM AND THE BFS SYSTEM SUMMARY DISPLAY. THIS ALLOWS THE FLIGHT CREW TO RESPOND TO A PNEUMATIC HELIUM SYSTEM LEAK INDEPENDENT OF GROUND CONTROL.

- APPROVALS -

S&R ENGINEERING	: W.P. MUSTY	:/S/ W.P. MUSTY
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P.A. STENGER-NGUYEN
DESIGN ENGINEERING	: CHARLES EBERHART	:/S/ CHARLES EBERHART
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: JEFF MUSLER	:/S/ JEFF MUSLER
USA SAM	: MICHAEL SNYDER	:/S/ MICHAEL SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: BILL PRINCE	:/S/ BILL PRINCE